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PRIVATE SECTOR INVOLVEMENT IN CIVIL SPACE REMOTE SENSING

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Prepared by
An Interagency Task Force

National Aeronautics and Space Administration

Department of Commerce/
National Oceanic and Atmospheric Administration

Department of Interior

Department of Agriculture

Department of Defense

Environmental Protection Agency

U.S. Army Corps of Engineers

Department of State

Volume 1 -- Report

PRIVATE SECTOR INVOLVEMENT IN CIVIL SPACE REMOTE SENSING

TABLE OF CONTENTS

SUMMARY OF REPORT ON PRIVATE SECTOR INVOLVEMENT IN CIVIL SPACE REMOTE SENSING

Volume I

This report responds to the President's request of October 1978, that NASA, the Department of Commerce and other interested agencies develop a plan of action to encourage private investment and participation in civil remote sensing systems. The report focuses on earth resources systems since their data products already enjoy a significant private market and because the results could apply to other remote sensing systems as private uses develop for them.

A survey of private sector developers, users and interpreters of earth resources systems/data, conducted for this report, indicated positive interest in participation beyond the current hardware contracting level. Because this interest has not fully matured, i.e., because the combined government and public markets fall far short at this time and at current price levels to produce revenues sufficient to meet system costs, the private sector does not yet appear prepared to make investments to operate a system or its major segments. Nevertheless, it is very anxious to "keep the door open." There is consensus in the private sector that the government should discontinue certain practices which are judged to compete with the private sector, that simpler and cheaper systems more responsive to private sector needs are required, that government "open" data policies are valid, that foreign access to data (including direct access) should be continued, that government regulation of private operation of systems will be necessary, and that government subsidy will be required for some time to bridge the gap between cost and likely revenue.

A market analysis indicates a substantial gap between current market levels (about $5 million per year) and system costs (upwards of $100 million per year). U.S. government needs account for about half of this market, foreign users (both government and private) about one third and U.S. private users the rest. With a four-fold increase in data prices (which, it is believed, the market could tolerate) and a reasonable annual growth rate over the next decade, this gap might be narrowed to $40—$60 million. Virtually all options for operating systems look to the government to fill this gap, either by operating the space segment at low or no cost to a private operator or through some other form of subsidy. Such cost-sharing between the public and private sectors is widely viewed as justified, as well as necessary, because of the heavy mix of public and private benefit which characterizes earth resources satellite services. (The fact that earth resources space systems are not yet economically viable does not detract from the public benefits they offer. Rather, earth resources systems are unique among remote sensing systems in that they add private to public interest.)

Issues identified in the study include the selection process for an operating entity, the public/private interface, data collection and access policies, price and profit regulation in a subsidized system, international participation, and the responsibility for R&D. In particular, it was agreed that the cost, complexity and security implications of integrated systems need not be an absolute bar to their private operation but could discourage it.

Six options are analyzed for private investment/operation of an earth resources system. All explore financial and institutional approaches. All are largely independent of the particular technical configuration of the system. However, the report strongly recommends against the selection of a given option at this time on the ground that an invitation to submit proposals addressed to one option would narrow the proposal responses and exclude other useful proposal responses addressed to other options. Instead, the report recommends that the Administration make clear its readiness to entertain proposals addressed to a specified set of public interest criteria, among which the most important would be the potential for reducing government cost. A specific plan of action identifies tasks to be performed by a government mechanism in order to proceed further toward inviting, considering and acting on specific proposals, if any, from the private sector. Such a mechanism would require considerable authority in order to assure that on-going government programs pose no unnecessary obstacles to, but rather encourage, private participation, to define public and private data needs (i.e., system requirements) and deal effectively with the private sector in these and related matters. Recommendations for specific Administration actions to be taken both in the immediate and more distant future are specified. Finally, the close interaction between this report and the parallel report on possible integrated remote sensing systems requires that both reports be considered together before action is undertaken on either.

SECTION I—INTRODUCTION

Task

In his October 1978 statement on civil space policy, the President directed that NASA and the Department of Commerce, with the assistance of other appropriate agencies, develop a plan of action to encourage private investment and participation in civil space remote sensing systems. Subsequently, Dr. Frank Press, Director, OSTP, in a memorandum to Dr. Frosch, the NASA Administrator, dated December 20, 1978, asked that the plan be completed by June 15, 1979.

Context

The National Aeronautics and Space Administration Act of 1958 directs that space activities be devoted to peaceful purposes for the benefit of all mankind; the preservation of U.S. leadership in space science, technology and applications; and cooperation with other nations.

These themes have been reiterated and expanded upon in subsequent policy statements and actions relating to civil remote sensing to the point where cooperative activity and open and equal access to data by users, foreign and domestic, private and public, is now an accepted and expected principle of the U.S. civil space remote sensing program. It is apparent, however, that U.S. leadership will be increasingly challenged by foreign competition in all areas of civil remote sensing.

The President's policy statement of October, 1978 reaffirmed the commitment to U.S. leadership in space while fostering international cooperation. The President designated space applications a key element of a balanced U.S. space strategy and expressed his desire to:

- Increase emphasis on uses of space for practical and economic benefit
- Continue to provide data from Landsat to all classes of users
- Encourage the private sector to take an increasing role in remote sensing and its applications.

Dr. Press, in response to questions about the Administration's commitment to remote sensing, stated at the hearings of the Senate subcommittee on Science, Technology and Space in April 1979:

> "The Administration is committed to an operational remote sensing system—yet undefined, and the technology mix and institutional arrangements will evolve over time."

Two bills on operational remote sensing systems have been introduced by members of the Senate Committee on Commerce, Science and Transportation. Senator Adlai Stevenson introduced a bill (S.663) to establish an operational

Earth Data and Information Service on an interim basis in NASA; the President would recommend permanent arrangement within seven years. Senator Harrison Schmitt's bill (S.875) proposes the creation of a private corporation, the Earth Resources Information Corporation, as a "chosen instrument" to be regulated by the Federal Communications Commission. The bill provides for transfer to the corporation of all existing related activities now conducted by other government agencies.

A related study on the possible integration of different remote sensing systems was undertaken at the direction of the President simultaneously with this study. NASA chaired an interagency task force for this purpose, examining systems options and institutional arrangements for national integration of current and future remote sensing systems. This private sector study has been coordinated with the Integrated Remote Sensing System Study (IRS^3).

Scope of This Report

The several varieties of civil remote sensing activities conducted from space are:

(1) Earth Resources Sensing—Focuses on surface features. In the R&D stage under NASA lead for the past 10 years; some data users now operationally using information derived from the space-acquired data supplied by DOI.

(2) Environmental Sensing—Focuses on atmospheric parameters. Operational systems under NOAA responsibility; NASA responsible for R&D.

(3) Ocean Sensing—Focuses on sea-surface features and sea-atmosphere interfaces. In the early R&D phase under NASA responsibility.

This study does not specifically address satellite remote sensing requirements necessary for national defense purposes.

This report deals specifically with the potential role of the private sector in the ownership and operation of space remote sensing systems as a commercial enterprise. It does not address development of the private sector role as a user of remote sensing except as it pertains to estimating the future size of the market for remote sensing.

Focus

During the course of this study, it became clear that the private sector participants consider that their prime opportunities for *investment* in satellite remote sensing are associated mainly with earth resources satellite systems (Landsat) and with future systems that may be complementary to them (e.g., Stereosat and the Large Format Camera). The analyses and recommendations discussed in this report therefore focus on earth resources systems, but in many respects the options available for ownership and operation of the space and ground segments would be applicable to environmental and oceanic remote sensing systems as well, particularly if private sector user markets develop for their products comparable to that market for earth resources data products.

The judgment that earth resources satellite systems and services offer the best current opportunities for private investment rests on the strong combination of government/public interest with growing commercial prospects. A user market is developing: domestic and foreign, government, private, and commercial. Strong private sector interest has been expressed in the operation of various segments of current or future earth resources systems. Timely consideration of future operational arrangements which will encourage the private sector appears warranted.

Operational environmental satellites exist and are an essential element required to meet the Federal responsibility for services to protect life and property and to be responsive to defense needs. In the light of the dominant requirements of Federal programs and considering the present policies of availability of data to other domestic and foreign users, there is little opportunity to expand private participation in the space and ground segments except perhaps in some mode whereby the private sector might build and launch satellites which would then be leased to the government. Such a proposition would be based on efficiency rather than development of a commercial market and each proposal would be considered on its own merits. However, it is anticipated that there will be a steady expansion by the private sector in information extraction for specialized uses utilizing data from the environmental satellite systems.

Ocean satellite systems are excluded from this study because they are still in an early R&D phase. While there may be market prospects, they are less developed than in the earth resources field. Studies by DOD, NOAA, and NASA are presently underway, but there is no federal commitment to either additional experimental or operational systems at this time. As with the environmental satellite systems, any private sector proposals that are offered should be evaluated on their merits.

Premises

The following premises are presumed to apply:

(1) Broad social and economic benefits, both domestic and international, are implicit in the application of remote sensing technology. It is therefore in the national interest to make these data widely accessible for general use.

(2) Private sector ownership and operation of the space and ground segments of remote sensing systems are deemed to be in the national interest to the extent that the private sector could:

- perform those functions more efficiently and economically than can the government.
- more aggressively market remote sensing data, expanding their use, achieving economics of scale and increasing data sales to the point that they might pay for all or a substantial part of a remote sensing system.
- stimulate innovation in the development and transfer of the technology.
- be more responsive to the needs of users in the private sector.

(3) Some few firms have sufficient knowledge of and confidence in the satellite remote sensing field that they are willing to consider seriously the potential investment of substantial amounts of risk capital to broaden its role in the field.

(4) The premises underlying private sector involvement apply whether that involvement is total or is limited to a portion of the system only. If it were limited to the ground segment only, the investment required would be greater than exists at this time and would contribute to realizing the benefits from satellite remote sensing.

(5) The field of satellite remote sensing is evolving and growing with respect to technology development and market maturity, and a continuing government/industry partnership over a number of years will be necessary to bring the field to its full maturity.

Some perceptions, often contravening, are noted:

- Federal Government policy for open access to data tends to reduce motivation for investment in some parts of the private sector.
- International involvements in satellite remote sensing systems have been negotiated on a government agency basis. Industry-based negotiations may prove more or less difficult.
- The profit motive inherent in private sector investment may at times limit or be in conflict with the social and public good that can be derived from satellite remote sensing.
- Experience in commercial communication satellites suggests that when these systems are the sole responsibility of the private sector, research and development on advanced systems may be neglected by both the private sector and the government.
- Foreign governments own and operate satellite remote sensing systems or plan to do so in the future. Private responsibility for U.S. systems would put private firms in competition with foreign governments.
- Many of the efficiencies and economic advantages postulated for private sector ownership and operations could also be achieved in well-managed government operated systems.

The premises and opposing perceptions noted above have been factored into the considerations of this report and its conclusions.

System Elements

The principal elements of remote sensing satellite systems are the space and ground segments—the latter including (1) data preprocessing and distribution and (2) data analysis and information extraction—and the end user community.

Space Segment—The space segment, presently funded, operated and owned by the government, includes the spacecraft, sensors, and ground-based satellite control equipment and software. The aerospace industry develops

and manufactures systems hardware and provides technical support under contract to the government.

Ground Segment—Ground segment facilities receive the raw data from the spacecraft and pre-process the data into identifiable (time, location) geophysical measurements in standard formats within certain minimum specifications. Archiving and distribution of the data is closely linked with the preprocessing and is considered part of this element of the ground system. The Federal Government is responsible for this activity in all existing satellite remote sensing systems, with many of these functions being performed by contractor support personnel.

Secondly, the ground segment is concerned with specialized data analysis and information extraction—also called the "value-added" service. While much of this specialized data analysis and information extraction is performed by the end user, e.g., meteorological information developed by the Federal Government, for Landsat some of this data analysis and information extraction is performed by the value added services firms in the private sector.

User Community—The end user community is represented by a broad spectrum of domestic and foreign interests in government and in the private sector. In fiscal year 1978, over six thousand different customers purchased Landsat data from the EROS Data Center; however, about one hundred of those customers accounted for the majority of sales. The use of data relating to nonrenewable resources is the most mature, with many oil and mineral companies and government agencies routinely using space remotely-sensed data. The use of data relating to renewable resources, which requires repeated assessment of changing conditions and rapid delivery of data, is still largely in the experimental stage. The government is the leading sponsor of the development of technology for renewable resources applications.

SECTION II—PRIVATE SECTOR VIEWS

Current Private Sector Involvement

The private sector's participation in civil space remote sensing to date has been in the following areas:

- The development and building of the R&D and operational systems hardware and software, and the technical support to the data processing and distribution segment under government contract
- The development and provision of analytical hardware, software, and services to private and government users on a commercial basis
- As users of the derived information for management purposes

A few private sector companies and groups, anticipating the commercial potential of government and private uses of the data, are presently expressing an interest in more direct involvement in all systems activities. This involvement could include ownership and operation of total systems or system segments as well as greater opportunity to develop the commercial markets for data and data analysis.

Survey of Private Sector

In order to develop an appropriate plan for encouraging greater private involvement it was considered appropriate to first determine the private sector's own views as to its interests and readiness, and the conditions under which it considers private participation acceptable and appropriate. To obtain the private sector views, interviews were conducted with over 50 firms, institutions, or individuals involved in space and ground segments development and manufacture, data processing and analysis, training, data use, system operations, and finance (Appendix 3). Announcements were also placed in the *Commerce Business Daily* and the *Federal Register* to obtain formal responses and insure maximum coverage (Appendix 4).

The interviews and announcements were structured to elicit views on system and data requirements and/or preferences; market potential; the government role and regulation; institutional or corporate arrangements; investment considerations; capital availability and incentives required; international considerations; including the effects of foreign competition; and the time frame in which private investment is considered feasible.

Summary of Private Sector Views

A general interest in some form of greater private sector involvement in civil remote sensing, primarily focused on earth resources systems and uses, was expressed by the majority of respondents. Major firms with experience in space activity and analytical service firms that have been directly involved in the various aspects of the Landsat development program had developed the most complete views and offered the most knowledgeable observations on the

questions and issues raised. However, with some few exceptions even those firms have not extensively detailed their thinking on preferred system configurations, market potential, investment, or capital availability. There is general agreement that potential public and commercial benefits are significant and that in the public interest the government will continue to be a major user of data products and services. This study and the attendant survey of the private sector views appears to have stimulated in a few firms more specific consideration of the factors involved in undertaking private ownership of civil remote sensing systems.

A summary of the views expressed are presented below and more completely discussed in Appendix 5. Some of the conceptual business approaches are reflected in the options presented in Section VI.

Interest—No single firm was seriously thinking of making a proposal to take on responsibility for a comprehensive earth resources system, such as Landsat. Such an approach is generally considered to be premature.

General long-term interest, however, is evolving into a near-term desire by some firms for selective participation. A few firms that believe they have an advantageous position or expertise due to their current involvement in space businesses are considering proposals focusing on their area of experience. Proposals may be forthcoming for private acquisition and operations of the ground segment of the earth resources system, for privately-owned leased services of environmental sensing systems and for specialized earth resources (stereosat) services—if the government indicates a willingness to seriously consider these proposals.

Most firms wish for the government to "keep the door open" so they may consider making proposals as business opportunities become more apparent. They are anxious that the government take no action which would limit competition or deter broad private interest initiatives.

Market—Future demand for data is considered promising but the level is uncertain. Specific future estimates of earth resources data sales were not available. Data requirements based on repetitive and nonrepetitive coverage are not clear at this time. Specific requirements for stereo data were estimated by one respondent.

There is a general consensus that the federal government does now and will continue to make up the largest share of the market for earth resources data and services. Considerable additional government support will be necessary for several years since the current data market at prices now charged including the government's share, will not support system costs.

There is a strong conviction that market development is best done by the private sector but requires assurances against government competition.

Benefit—Public and private benefits are considered to be significant, requiring continuity of service and establishment of an operational system.

Systems—Views differ as to preference between Landsat C and D types, Stereosat, and single all-purpose vs. several specialized systems as they apply

to operational user requirements. There is a consensus that 10m instantaneous field of view meets most public needs though some thought this resolution may not be required. There is interest in new cost-effective technology, e.g., "push-broom" linear array sensors. There is a preference for independent civil and military systems but also a readiness to operate in an integrated system mode if necessary, although it is thought the complexities involved might deter private investment.

Data Policies—The U.S. position on open nondiscriminatory availability of civil system data is generally supported. However, there is a smaller contrary interest in providing special data "exclusively" to user/investors as a condition for private funding of a specialized system. The private sector believes Landsat data prices should be increased and probably can be raised several times without adverse impact. Legal protection will be required against unauthorized duplication and resale for a reasonable time period. No considered position was apparent on the issue of the privacy of high resolution data of private property or resources. There may be an assumption that this will be left to the courts as is the case in similar airborne remote sensing issues.

Government/Industry Relations—The private sector considers that government subsidy and/or strong market support to private operations of the space segment will be necessary in view of the current size of the market and the "public interest" value of the system. Most firms assume that the logical government subsidy could come in the form of funding of the space segment. While it is recognized that complex integrated systems and security could complicate private sector initiatives and participation, no insurmountable problems are foreseen. It is expected that government regulation will be required and is acceptable. There is a consensus among private firms that the government should stop "competing," especially with value-added firms. Continuation of government R&D is urged, but not in a manner that competes with the private sector activities.

International Considerations—The possible effects of foreign competition on U.S. satellite systems, data sales, and ground station sales contributed to private sector uncertainty. A general view was expressed that a positive decision is needed on a U.S. operational system to maintain U.S. technological and market leadership. There is also concern that planned foreign systems, probably subsidized, may divide and undercut the market.

Direct access by foreign stations to U.S. satellites should be continued, but a access fee more closely related to system costs and benefits, should be levied and foreign stations should be prohibited from undercutting U.S. prices. Declassification of high resolution data could create international concerns, as well as undercut the market for data from civil systems.

SECTION III—MARKET DESCRIPTION

Industry/Business Profile

Currently, the private sector is involved in all three Landsat system segments or business areas, including support of data sales. In the space and ground data-handling segments, private industry's involvement is solely as a contractor to the federal government for the design and construction of spacecraft, sensors, ground data handling equipment and software, and as an on-site support contractor providing a broad range of operations and analysis support in satellite launch and control of spacecraft and in tracking and acquisition. However, in the analytical services area, there is growing competition to provide equipment and services for the analysis of remotely sensed data for the ultimate user.

Present market expenditures are as follows:

- Space Segment (Government Contractor Services) — $80-100m/yr.
- Ground Data Handling (Government Contractor Services for Preprocessing, Archiving & Dissemination) — $10-25m/yr.
- Analytical Services and Equipment (Diversified Private Services) — $30-45m/yr.
- Data Sales from Landsat (Government Service) — $4.8m/yr.

The above contractor markets related to the space and ground data handling will be available to private industry regardless of whether the system operator is private industry or the government. Similarly, the private sector will be, as it presently is, involved in the provision of analytical services and equipment in the case of either government or private system operation. For practical purposes, the market available to directly defray the cost of system acquisitions and operation is essentially only the data sales market.

Data Market

This market is characterized by a breadth and diversity of uses and customers not found in other space remote sensing fields.

The FY 1978 market level for earth resources data was about $4.8 million. The customer mix was:

Federal Government - 52%
U.S. Private Sector - 12%
Foreign Purchases - 27%
Other (universities, state and local, miscellaneous) -9%

The growth of this market has been constrained by the R&D status of the system—the changing format of the data products (imagery versus computer compatible tapes), time delays in the availability of data products, the uncertainty of data continuity, and the need for development of techniques and the general education of users and their specific training in methods of converting the data into management-oriented information.

Earlier studies have predicted potential public benefits from an operational Landsat type system to be in the range of $0.5 to $1.0 billion annually. It is these large benefits that give rise to the belief that a large market for data will develop.

Basis for Future Market Estimates

The period of interest is from the present to 1990.

Estimates of the magnitude and nature of current and projected data sales and related analytical service markets were obtained from representatives of federal, state, and local agencies involved as suppliers and/or users; private industry and private users involved in remote sensing or related activities; and, where available, from previous studies from all sources. High and low estimates were made reflecting both aggressive/optimistic assumptions and conservative opinions (Appendix 7).

Current Market (FY 1978)

Data Sales			
EROS Data Center/USGS	$2.0m		
USDA	$ .1m		
NOAA	$ .05m		
Goddard Space Flight Center/NASA (equivalent)*	$2.0m		
Foreign	$ .6m		
		Subtotal	$4.8m/yr.
Foreign Station Access Fees (Six stations operating)			$ .85m/yr.
			TOTAL $5.65m/yr.

*This represents data furnished without charge to principal investigators, federal agencies and participants in joint technology transfer projects.

Projected Market (1982-1990)

Data Sales — **$40-80m/yr**

- Projecting 10-20% growth/yr & 4 x price increase
- Factors supporting optimistic market growth projections:
  - Imagery sales are declining but larger growth expected in higher priced CCT's.
  - Landsat D Thematic Mapper should attract more users
  - State and local users will slowly organize and budget for use
  - Foreign users will increase (assisted in part by AID)
  - U.S. agencies project modest increased growth in use of data
  - Possible new systems could increase market (Stereo, Large Format Camera, Push-Broom Scanner)
  - Increased revenue through price increases (data purchases relatively insensitive to price)
- Factors adverse to market growth:
  - Foreign competition
  - "One time," or nonrepetitive purchases by some classes of users

Foreign Station Access Fees (15 stations projected) — **$3m/yr (minimum)**

TOTAL $43-83m/yr

SECTION IV—POLICY ISSUES

The unique policy issues to be expected in private sector ownership/operation of space remote sensing systems relate to the obligations of the U.S. Government and the sensitivities associated with the gathering of information on a worldwide basis, access to that information and the price to be paid for it. In addition, there are broader issues of government/industry relationships, including regulation of systems and operations. The policy issues that must be dealt with, and the task force's comments on each, are as follows:

Public/Private Relationships

Chosen Instrument vs. Competition—A "chosen instrument" is defined as a public or private corporate body selected and sponsored by the government for the exclusive ownership and operation of a system. The initial selection could be made with or without competition, but its effect is to exclude competition thereafter. The instrument could be a new one as defined by Senator Schmitt's Bill (S.875), an extension of Comsat as that Corporation has publicly proposed, or it could be another new or existing body.

The granting of an exclusive operating license is not of great concern since it may be doubted that there is economic room for more than one domestic system in any case. However, there may be more concern over the initial selection of a chosen instrument unless the selection is competed in the public interest.

Competitive selection could significantly reduce the government's cost in support of remote sensing systems. The greatest scope for competitive response in the public interest could be assured if the government were to invite competitive proposals from all interested U.S. sources to meet general public interest criteria, rather than inviting proposals for a pre-selected (narrow) option for a given system and/or modality. (See Plan of Action.)

Government Interface—There is need to designate a single government agency to carry out the tasks associated with effecting a possible transition from government to private operation (see Plan of Action) and to continue oversight of remote sensing activities.

A central purchasing arrangement through a single agency to satisfy government data needs from a private operator does not appear warranted unless the government guarantees to purchase a given volume of data from the system owner/operator. Interposing a single agency between the user agencies and the systems operator for managing government purchases could otherwise negate some of the opportunities for market development inherent in private ownership/operation of remote sensing systems.

Government Competition—Government activities, when perceived as competing with private sector activities, can operate as a deterrent to greater private sector participation unless the plans and limits of the government's activities for all system segments are clearly defined. This would apply also to

government R&D. A private operator would need to know government plans for R&D over a projected time period (i.e., 5-10 years) calling out sensor types and frequencies to be flown, new data transmission and processing techniques to be explored, and experiments to be conducted. The means and timing by which the results and data will be disseminated should be made available on a regular basis. Data from government R&D sensors may compete with commercial product sales. Therefore, issues regarding data dissemination and transfer of new technology to the private sector will have to be addressed.

The government now operates the EROS Data Center to provide the common pre-processing of Landsat data to meet the needs of federal users and to archive the data for future use. If it is determined that it is in the best interest of the nation for the private sector to own and operate a future ground data handling segment, the government must not compete with it. Any pre-processed data made publicly available by the government should be a negotiated exception.

For specialized processing, information extraction and analysis services, the government should limit its own activities to support of its own missions in order to contribute to the growth of the market for added value services.

Research and Development—The government should continue to support R&D programs to improve the effectiveness and capabilities of remote sensing from space. This R&D should be done in the most cost-effective manner with due consideration of the opportunities to conduct this R&D using the private sector systems.

Financial Issues

Pricing—It is evident that the price level for remote sensing data from privately owned systems would have to be increased, if it is to be keyed to the real costs of acquisition, preprocessing and to a reasonable return on investment. However, the price increases should be moderate to encourage wide public use and should be nondiscriminatory. Especially if government support or subsidy is involved, the price structure might be regulated in much the same manner as public transportation rates are established.

Profits in Subsidized System—Public interest would suggest that profits as well as prices be regulated in a government-supported system.

Data Issues

Access to Data—The tradition of open access to data for civil sensing system is valuable and should be maintained beyond the Landsat series unless overriding national interest considerations arise in special circumstances. Any other approach would be difficult to defend if the system is to be supported by public funds and our international posture of openness and cooperation is to be maintained.

A private operator must be constrained by regulation to provide equal access to system output, preclude discriminatory access by special interests, and avoid any conflict of interest arising from his own position in the system.

Direct Access by Foreign Stations—The current access fee ($200K) is a nominal charge which was implemented to establish the principle of payment for access. In an operational system the fee should be raised to take into account system and data acquisition costs, value of the data to the user, amount of data acquired by individual stations, and income from data sales by the stations. If there is a private operator of the space segment, the annual fee should be paid to that operator. As more foreign stations come on line, any U.S. Government subsidy to the private operator should be reduced accordingly.

Encryption—In an independent civil system, the data may be encrypted to preserve the commercial integrity of the venture, but should be available on an equal basis to authorized ground station subscribers, foreign and domestic. In an integrated system, the same would be true for the civil component, but the military/intelligence component should be accessible only to classified U.S. stations.

Data Protection—It is expected that it will be necessary to protect against unauthorized duplication or resale of data in order to provide maximum commercial integrity of the enterprise. Some form of copyright or possible special legislative protection may be required to provide this assurance.

Privacy—As the sensor resolutions of the system are improved, questions regarding liability for invasion of privacy can arise. Current development of law on privacy considerations in air reconnaissance cases, suggest that this issue could be left to the courts.

Continuity—Provision for assuring data continuity to government and private users by private operators will be required.

Operating Issues

Security—Any requirements for security in a privately-operated system can be handled through governmental presence and regulation, since private firms already are handling secure systems.

International Issues

International Obligations—It is now well recognized that the government is responsible for international agreements on remote sensing activities. The private sector operation must be authorized and continually supervised so as to conform to U.S. international obligations.

International Institutionalization—Considering the overall international economic context and the special problems that have developed in INTELSAT since its inception, commercialization of Landsat-type systems should be attempted and advanced domestically before organization of an

international entity is attempted. This is also consistent with Administration policy. However, the way should be left open for subsequent international arrangements.

Private Sector Role Assessment

There appears to be no real limitation, assuming compliance with government regulations and policy, on private ownership or operation of remote sensing systems as long as there is both adequate government funding and a commercial market to make such private investment feasible.

SECTION V—FINANCIAL CONSIDERATIONS

Conditions Required for Private Investment

Discussions with the private sector made it clear that their interest in investing in remote sensing systems or segments thereof will be translated into action only if they can perceive that a return on investment (ROI) is highly probable at a rate comparable to that available from other risk investment opportunities. To provide that assurance, there was general belief that the state of market development now may require government support of remote sensing systems in addition to providing the largest share of the market for data. Analyses were, therefore, conducted to determine the level of government support required, including subsidy, and to compare (1) the cost to the government of providing that subsidy as part of a leased system service with (2) the cost of government ownership and operation of the system.

Government Subsidy Required

Two systems, representative of systems to provide operational remote sensing services, were analyzed: a follw-on to Landsat D/D' and a specialized Stereosat system. Since the government subsidy required would be strongly affected by the total revenue from data sales, including both commercial and government purchases, two future levels of market volume were assumed for the Landsat type system, $40m and $80m, to be achieved by 1989 (Section III). Fifty percent of these sales are expected to be government purchases. For Stereosat, the market projections of an oil/mineral exploration group were used, i.e., $20m/year.

For the Landsat follow-on system to be owned/operated privately, the government subsidy required to provide a 20% ROI, a level considered typical of such investments, would be $30m/year, assuming the high market projection, or $55m/year assuming the low market (Appendix 8).

For the Stereosat system, the government support required would be $40M/year. There has been little interest displayed by government agencies in obtaining operational data from a new Stereosat system. Therefore, most of the government support would be as a subsidy.

The subsidy levels are directly affected by system costs and the ROI required by the private system owner/operator. Under competitive conditions associated with the desire to enter new markets having assured government support, it is possible that some companies would propose systems costing less than a government-specified system and would accept ROI's less than 20%. Should this occur, the annual subsidy for a Landsat type system could reduce to as low as $5m per year *for the high market assumption.*

Government Cost Comparison

"Own" system vs. "lease" system services from private owner

Computations were made to compare the "present value" cost to the govern-

ment at the time of initiation of services for a government-owned and -operated Landsat type system with leasing services from a private system operator. This analysis showed that the government's costs to own/operate the system would be $380m (over 10 years) compared to lease costs of $390m. These values assume identical systems costs for both ownerships, the same market conditions, and a ROI of 20% for the private investment.

Within the accuracies of estimated systems costs and market projections used in the analysis, the advantages of private sector ownership depends entirely on the assumptions made in the analysis. Factors such as the degree to which the private sector would develop the market, accept a lower ROI and achieve system cost reduction and operating efficiencies could make private sector ownership advantageous both to the private sector and the government. There are trade-offs in these factors which will have to be evaluated for each proposed private sector initiative.

SECTION VI—OPTIONS FOR PRIVATE INVESTMENT AND PARTICIPATION

Among the fundamental ways in which the private sector can be involved with the government in remote sensing programs are these: (1) as a contractor to the government, managing and operating government programs involving hardware or support services; (2) as a system owner, selling or leasing services to the government and/or the private sector; or (3) as a system owner contracting for government services, as for "piggy back" space transportation by NASA, NOAA, or DOD. The options considered in this study for private sector/government relationships cover these three forms and appear to be basically independent of any specific system configuration.

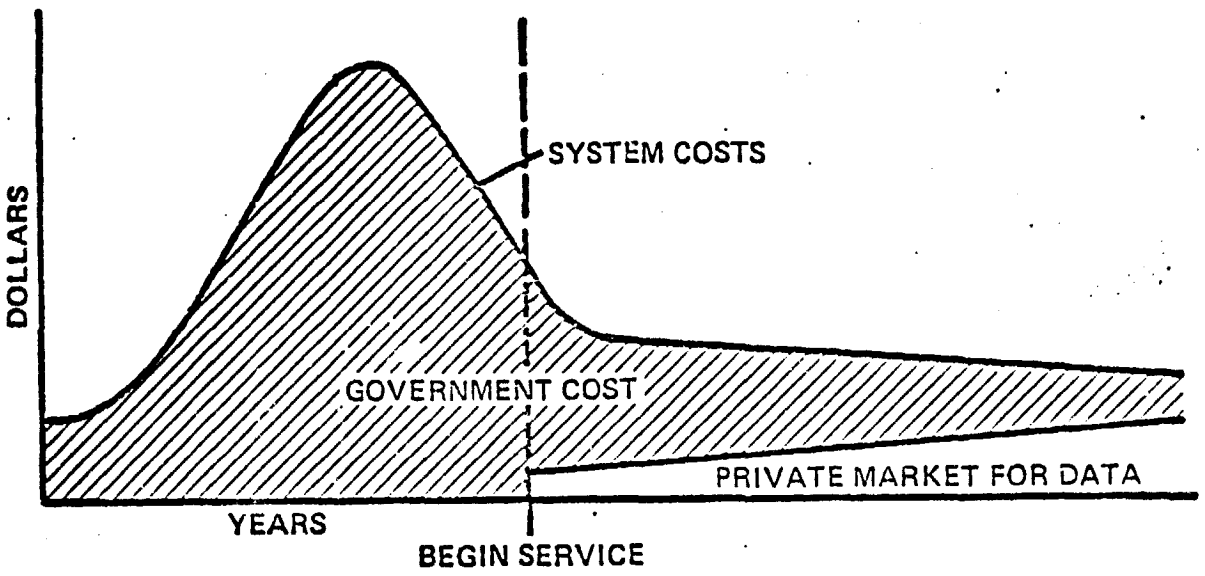
The options were selected to represent the most realistic alternatives for private sector participation and investment in recognition of the present state of system development and operation. Each represents a different level of private investment and risk taking and might be applicable at different stages of program and market development.

The options can apply to a total remote sensing system or any segment thereof; i.e., space segment, complete ground segment, or portions of either, such as, the data preprocessing element, the data distribution/sales element, etc. The relative level of private investment involved, however, can vary greatly, e.g., the space segment costs from four to seven times the ground segment.

All of the options reflect the private sector opinion that private investment will be feasible only if federal government support will be available and assume that the level of government support can reduce as the private market develops. The option selected can have a major bearing on the development of the private market, since it is generally thought that the greater the financial commitment of the private sector to remote sensing, the greater will be its interest in market development.

"Value added" analytical services, software and related equipment are already in the private sector and so are not specifically addressed by the options.

NO. 1 -- GOCO OPTION
(GOVERNMENT-OWNED PRIVATE MANAGEMENT AND OPERATION)



Characteristics

- Government owns system—pays frontend and operating costs
- Contractor has broad discretion to develop and deliver services of system/subsystem
- Contractor can market products/services to additional customers
- Government and contractor share revenue from developing market on prorated basis

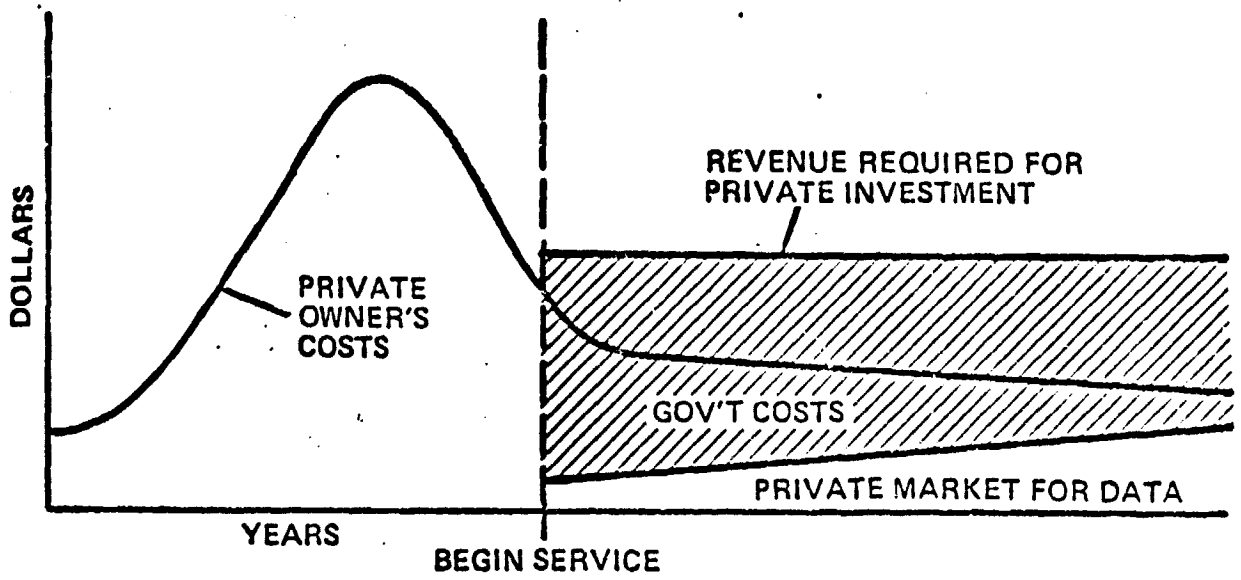
Advantages

- Prospects of reducing government's costs of operation
- Operator motivated to find new markets
- Government retains system control-system flexibility
- Minimize government personnel involvement
- Easier to attract broad private interest

Disadvantages

- Government meets all frontend costs
- Major budgetary fluctuations
- No risk sharing by contractor
- Little motivation for operator to reduce system cost

NO. 2 -- LEASED SERVICES OPTION



Characteristics

- Private owner puts up frontend funds and operates system/subsystem
  Suboption: Buys existing system from government *or* develops own system/facilities
- Government leases services at rate to provide adequate return to private investors
- Government costs begin when services begin
- Contractual requirement to reduce government's costs as the private market develops
- May require special legislation and waiver of congressional budget procedures

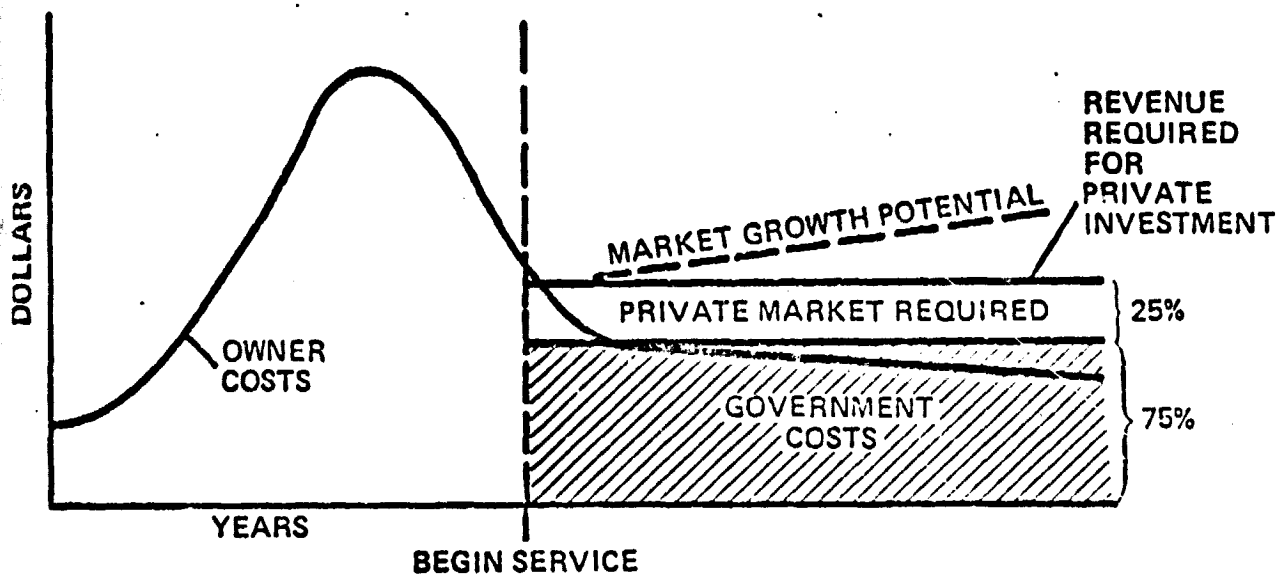
Advantages

- Government avoids frontend costs
- Government pays nothing till service begins } Smoothes budgeting
- Transfers all or most of risk to private sector
- Motivates operator to develop long-life, cost-effective systems
- Operator can build in capability beyond government requirements to serve private market and reduce government cost
- Major incentive for operator to expand market

Disadvantages

- Government-leased total cost may eventually be higher than if government had developed and operated system itself
- Does not provide for *maximum* encouragement of private market development
- Less system flexibility for R&D

NO. 3 -- "COMSAT"* OPTION



Characteristics

- Private operator develops, owns and operates system
- Private operator meets frontend and operations costs
- Government to provide 75% of revenue required to make investment feasible by purchases of data and services
- Operator takes risk on market development to recover remaining 25% of investment plus profit
- Government assumes no system risk
- May require special legislation and waiver of congressional budget procedures

Advantages

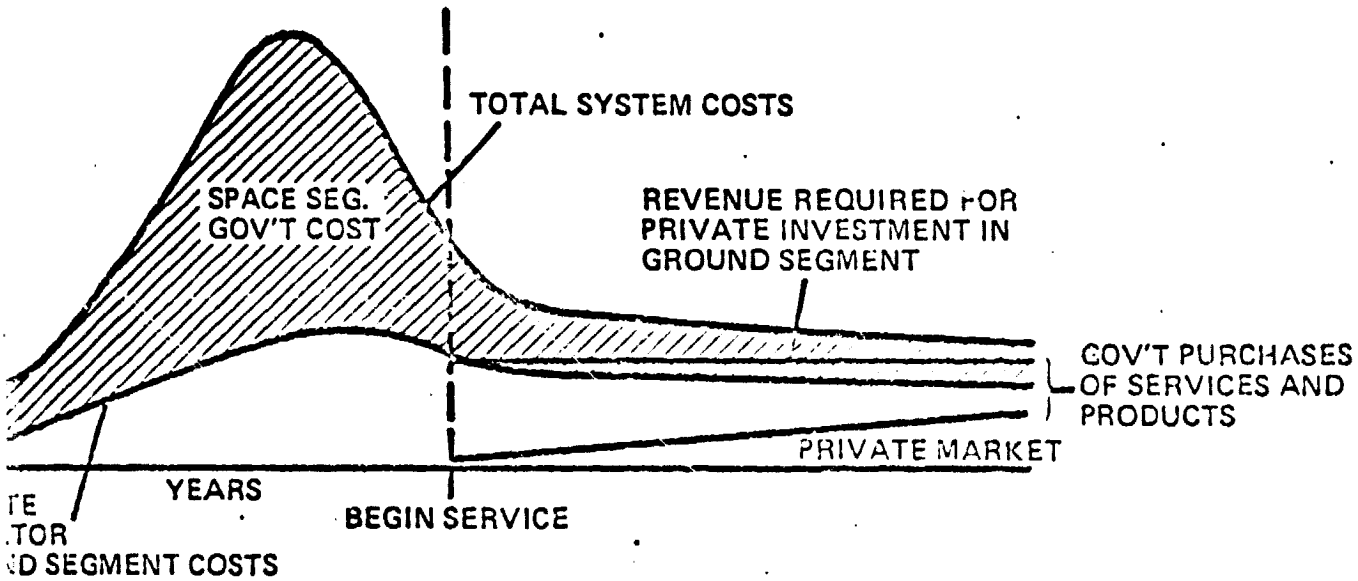
- Same as Leased Services Option
- More motivation for operator to develop markets

Disadvantages

- Political issue regarding sole source selection (though in principle, this option could be competed)
- Government share of costs not reduced as market grows (unless specific provision is made for this purpose)
- Government data needs are at risk if private operator defaults or abandons system

*Operator need not be Comsat Corp.

NO. 4 -- GROUND SEGMENT OPTION



Characteristics

- Government owns and provides *space segment*—both up-front and operating costs
- Company provides *ground segment* elements (facilities and services—both up-front and operating costs
- Ratio of space to ground may range from 4-1 to 7-1
- Government procures data and services from company
- Government can arrange contract to stimulate private owner to develop private market

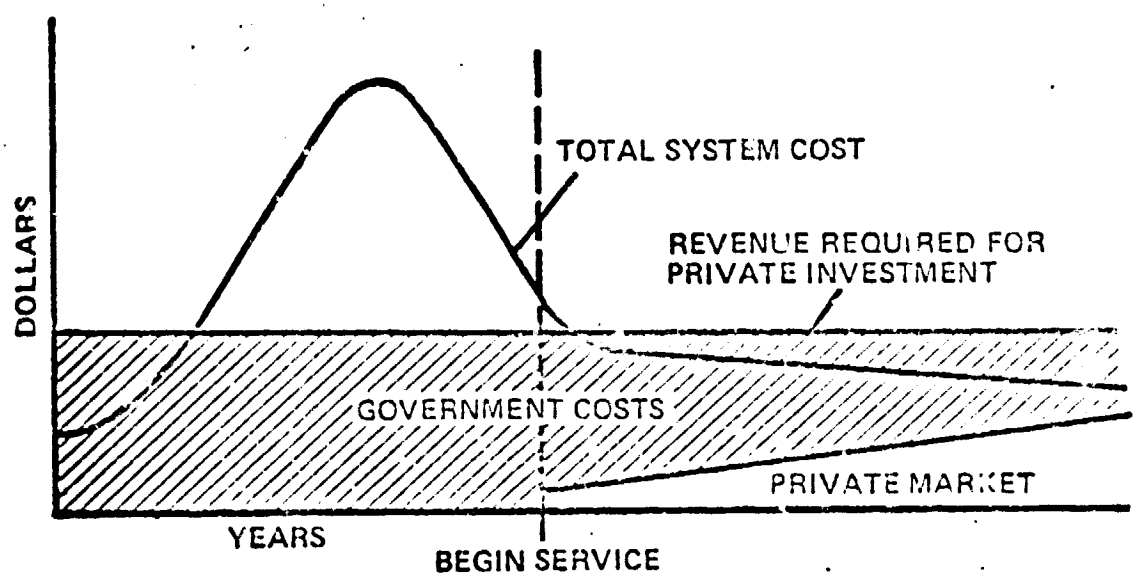
Advantages

- Same as Leased Services Option but for ground segment only
- Advances private sector participation (company takes over facilities now under development)
- Motivates private sector to establish cost-effective ground segment and expand market
- Can reduce government costs for ground segment

Disadvantages

- Requires continuing large government investment in space segment
- Reduction of total costs for government is relatively small percent of total
- Company tasking of government satellite could present difficulties
- Government users may pay more for data than under government ownership and operation or GOCO.

NO. 5 -- SHARED COSTS OPTION



Characteristics

- Private company develops, owns and operates system
- Government starts payment for services at beginning of program
- Company markets data to meet or exceed agreed upon market level
- May require special legislation and waiver of congressional budget procedures

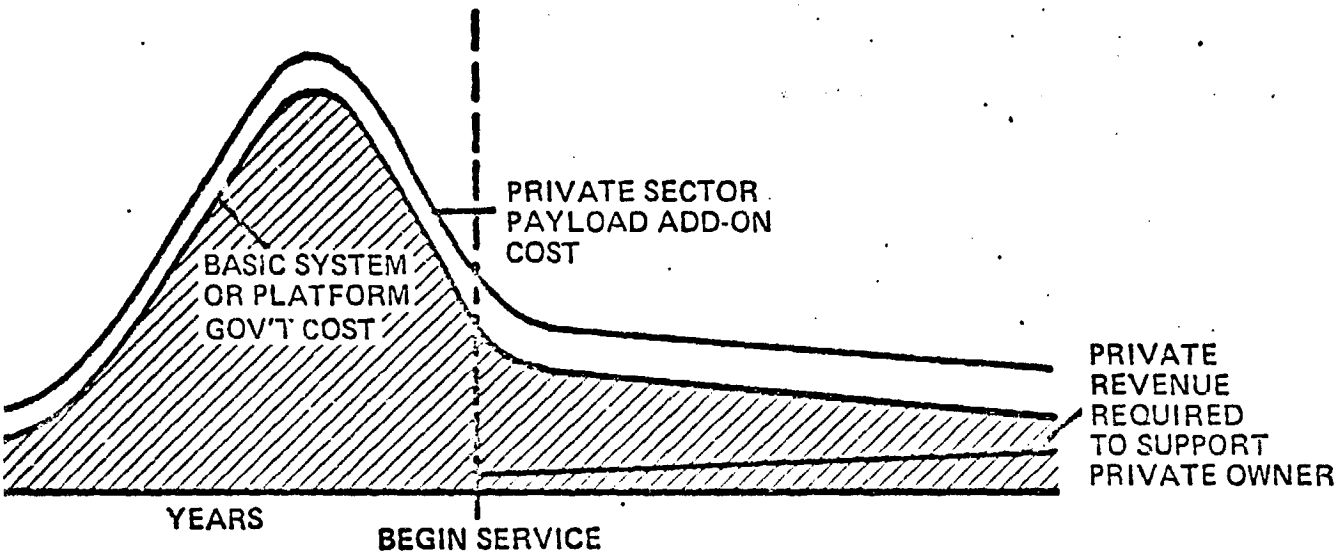
Advantages

- Basically same as leased services option but further reduces private venture frontend costs and risk and could attract broader participation (competition)
- Evens out budget cycles even more

Disadvantages

- Government shares risk of system development and performance
- Reduces private financing

NO. 6 -- "PIGGYBACK" OPTION



Characteristics

- Private instrument/system "piggybacks" on government platform or shuttle
- Private owner pays all frontend development and operating costs for added instrument/system

Advantages

- Encourages private sector entry into specialized remote sensing services of benefit to both government and private sectors
- Provides private incentive with minimum cost to government
- Motivates development of special markets for R/S data
- Particularly applicable to (e.g.,) stereosat, large format camera, radar and some possible IRS[3] scenarios
- Can combine commercial and R&D programs efficiently

Disadvantages

- Adds system complexity
- Does not relieve government financial operating burdens for continuing basic system operations

Discussion of the Options

In the broadest sense, the options can be viewed as offering an evolutionary range—the GOCO Option could provide a minimal risk opportunity for the private sector to be introduced to operational responsibility and market experience. The Leased Services Option offers a further step requiring private investment and broad discretion but with the government assuring the necessary financial return. The Ground Segment Option represents the several possibilities for private investment in any one of the major elements of the system with the private sector bearing the risk in some large part itself. The Comsat Option is a risk-sharing approach for a specialized (or comprehensive) service. An evolutionary path could be structured through these several options—or, if the private sector chooses, an early selection of one or another option could be made.

The options could apply to either present or future systems. To apply to present systems, existing or already under development, some private investment in or purchase of these government-owned systems would be required—but without the opportunity for private participation in their conception or design for the market. To apply to future systems, some early private sector—government cooperation would be required to define the system and its political-organizational context.

"Under any option, if a long-term Government financial commitment is required to foster private investment, such a commitment may require special legislation which, in turn, may require waiver by the Congress of the existing Congressional budget procedures."

Present Systems

In the case of present systems, two considerations operate against private investment in a total system (or in the space segment alone). First, no private interest has been expressed in acquiring present earth resources systems through Landsat D', apparently for reasons of cost and complexity. Secondly, the current levels of revenue from data sales are, by a factor of 20 or so, insufficient to reward an investor in these systems. Even giving the system at no cost to a private operator would not likely, in the current data market situation, put him in a way to profit.

Government sale of a current system to a private operator for lease-back of services might cost the government more than retaining ownership since the return on investment (ROI) required to attract a private investor is greater than the government's cost of borrowing money and this would be reflected in the government support which must be provided this private owner/operator.

The GOCO option does not provide private investment or ownership, but it could be viewed as a preliminary step in the event private investment is not forthcoming and a means of introducing a private operator into the arena, beginning the evolution toward ultimate private ownership of future systems. In addition, some beneficial market growth and operating efficiencies might be achievable from private sector operations/management. However, it might

also be viewed as a decision to maintain government domination of the space segment.

On the other hand, while there might be cost savings due to private operating efficiencies, there is no assurance that the government would save any money by going to the GOCO option. The interest of the private sector in this option has not been established and needs to be tested.

Another approach would be to establish a designated entity, either legislatively or by competition, to which the government would transfer system ownership at essentially no cost. This would provide benefits similar to the GOCO option, give the government less management control of its operations and probably require legislative authorization.

The piggy-back option, while an obvious evolutionary step, is not likely to be available in free-flying systems already under development since earth resources sensing systems are not now designed for the flexibility required. However, the shuttle will be able to accommodate piggy-back and specialized systems should private investors wish to use it.

New Independent Systems

The choice of system and institutional options for private investment is of course greater for new systems than for existing ones, primarily because the private sector would have the opportunity to work with the government from the outset in shaping the context and content of the program. Both parties can thus assess the best approach, based on market, technical, and policy considerations. As indicated in the Plan of Action following, all the identified options are available for any future private system, and since only one company (or none) is at present interested in any one option, the government can obtain the fullest response to an invitation to propose if it invites proposals directed to broad criteria rather than a single option. Under any of the options, it is apparent, based on cost comparisons made in this study, that significant cost savings will accrue to the government only if the private sector can expand the commercial market to a greater size than would the government or reduce systems costs.

The piggy-back option would be available for future systems to provide continuing opportunities for innovative private enterprise to advance the remote sensing field. Thus, provision could be made for the flight of new sensors or read-out equipments developed by the private sector. Various arrangements for government/private sector partnerships should be explored to encourage the private sector's interest in such endeavors.

Future Integrated Systems

Integrated systems, such as those being considered in the IRS[3] study, may possibly include configurations with the capabilities of meeting all or some military and civil remote sensing data requirements. Because of the tactical and strategic character of the military component of integrated systems, there may be some question as to their command and control by the civil

community. On the other hand, contractors already build and operate various types of military systems.

It should be possible to treat the civil and military components of an integrated system independently insofar as data handling is concerned. In addition, an integrated system may or may not lend itself to piggyback private payloads—which could operate as an important stimulus to further private sector investment and involvement.

In any event, it is evident that there may be complex technical and institutional interfaces resulting from a mix of private/government ownership in an integrated system. On the surface, these appear manageable, but this is an area which would require further consideration if the integrated system approach is adopted.

SECTION VII—RECOMMENDED PLAN OF ACTION

Philosophy of Plan

This plan of action reflects the views of both the private sector and the government agencies which participated in the preparation of this report insofar as both feel that it is too early to select specific options for conversion of the space and ground segments of the Landsat system to private ownership. This is not to say that it is too early for private participation but that it is too early to constrain the alternatives that might be put forward by the private sector.

It appears that the private sector is only now beginning to develop concrete proposals for major investment in systems, that thinking among different firms with regard to such proposals differs very substantially, that the shape of future systems is not sufficiently defined, that current government studies of the possible integration of systems will need extended consideration, that the technical and market potential of even Landsat D/D' is yet to be learned—that for all these and additional reasons it would be best to avoid selection of a single option at this time.

Instead, some time should be allowed to permit the private sector to further develop its thinking and offer a variety of approaches which may be evaluated in terms of the public interest. If the government were to select a single option at this time, it is likely that only one or two proposals, if any, could be expected from the private sector for implementing that particular option. Other equally or more advantageous proposals, current or potential, would be excluded, even though there would be other interested firms, because their interest would be associated with different options.

In order to stimulate the development and submission of all proposals which might be in the public interest, it would appear appropriate to request proposals addressed to general criteria rather than to a selected system configuration or particular institutional approach.

This section of the report suggests the public interest criteria which might be established as a frame of reference for possible private sector proposals that might be forthcoming, lists the tasks which the government must address in connection with the further encouragement of private sector participation and describes a government mechanism which is deemed necessary to discharge such tasks.

Public Interest Criteria

To encourage private sector investment in and operation of space and/or ground segments of earth resource remote sensing systems, or compatible systems such as the proposed stereosat, the government should clearly establish the criteria which it would apply to the assessment of individual or competing proposals. As noted above, the suggested criteria are designed to permit consideration of all reasonable proposals, even if of quite different character and

systems. In general, proposals for private sector initiatives should be judged on their relative merit in meeting objectives such as the following:

1. The extent to which they are generally favorable to the government and the economy, i.e., the extent to which they reduce the burden of government costs for the service.
2. The extent to which they reliably meet government and private sector needs.
3. The extent to which they are cost effective in meeting public/private needs.
4. The prospects for developing commercial markets for data and services.
5. The feasibility and extent of government support and involvement required.
6. The assurance that continuity of service to meet government requirements would be guaranteed.
7. Their amenability to the necessary government presence in and regulation of the system.
8. Compatibility with evolving domestic policy on remote sensing (including the many decisions which may follow from the study of integrated remote sensing systems).
9. Their compatibility with evolving international policies and commitment.
10. The extent to which they would accelerate private investment and participation (including the advantageous use of existing or planned government facilities.)
11. The extent to which they preserve or advance U.S. leadership in space remote sensing.

Tasks to be Performed

In general, the tasks to be performed if the government is to move toward major private involvement in remote sensing systems involve further communication with the private sector, control of future government system activities so as to reduce obstacles and facilitate a transition to the private sector, the further definition of the government needs, the receipt and assessment of proposals, their negotiation, ultimate commitment to a proposed set of arrangements with the definition and preparation of any enabling legislation that might be required.

Summarized, these tasks appear to be the following:

1. Development of further communication with the private sector.
2. Effective recommending authority with respect to government program actions which could obstruct or facilitate private involvement.
3. The definition of government requirements plus assessment of private requirements against which to judge the total adequacy of any system proposal.

4. Elaboration and recommendation of necessary government regulations plus procedures for monitoring compliance.

5. Further development and refinement of the recommended criteria (noted above).

6. Solicitation and/or receipt of private sector proposals addressed to the approved criteria.

7. The planning and conduct of negotiations with the private sector.

8. Commitment, in the negotiation process, to such government guarantees, assurances and funding as may be required.

9. Advise the legislative branch of Administration plans and positions on earth resources remote sensing and work with them in development in any enabling legislation that may be required.

In connection with the tasks of avoiding or removing obstacles to private sector activity in the field, action should be taken to reduce present deterrents, perceived by the private sector in the analytical services area, where there is high motivation to develop the private market further. In particular, the government should:

1. Reduce or eliminate government competition in the provision of analytical services;

2. Reduce time delays in the availability of data; and

3. Encourage private sector participation in transferring applications of remote sensing technology to state and local governments.

Government Mechanism Required

The tasks enumerated above are clearly formidable and will require that commensurate authority be provided to the governmental mechanism which must be established to discharge them. There is a fundamental option which the government has in establishing such a mechanism: it may be established in either a new agency or office or in an existing agency. Because there is already a multiplicity of agency interests in the earth resources sensing field and because the Interagency Task Force shares a general reluctance to establish additional government mechanisms, the task force recommends that an existing agency or office be given the responsibilities required.

In any case, whether an existing or a new office be selected for the purpose, the task force is very strongly of the opinion that there should be single-point management and coordination responsibility for discharge of the tasks enumerated. This means not only that a single office should be given the necessary responsibilities but that there should be a single responsible official rather than a committee within that office as its senior authority. However, the office should be staffed with personnel from all the interested agencies so as to assure that their views are represented in the development of issues toward final resolution.

It is believed that NASA, NOAA or the Department of the Interior should be assigned the responsibilities discussed here. Until a choice is made among these candidates one of these agencies should be designated to act as the focal point without prejudice to the final decision. It is further recommended that NASA continue to be responsible for R&D activities in civil remote sensing from space.

Recommendations for Early Action

It is recognized that the tasks listed above and the establishment of the necessary government mechanism, with adequate authority, will require some time. Some early steps are possible to preserve the momentum generated by the President's call for the current study, to lend further substance to it and to insure progress. Among the possible steps are the following:

1. The Administration should make an announcement along the following lines—

(a) Having received the current report, the Administration desires to take further steps to encourage private investment and participation in earth resources satellite systems, as well as other space remote sensing systems which may be of interest to the private sector.

(b) To remove any uncertainty which may trouble the private sector, the Administration repeats its commitment to provide for an operational earth resources satellite system and to encourage private participation and investment in it.

(c) To emphasize the Administration's desire to encourage private participation, a focal point for contact by the private sector in connection with earth resources remote sensing will be preserved in government. (A single agency should be designated for this purpose, coordinating with other interested agencies).

(d) Accordingly, the Administration will welcome any reasonable proposal from the private sector for investment in and operation of all or part of an operational system. The public interest criteria to which such proposals could be addressed would be published (see *Public Interest Criteria* above.)

(e) In addition, the Administration will take steps to minimize government activities in the earth resources field which have the effect of competing with established firms in the private sector, except as may be required by law or regulations, such as OMB Circular A-76.

(f) Recognizing that government programs under development may be configured to facilitate or discourage future private participation, the Administration will structure consultations with the private sector with respect to the final design and operation of those and future systems.

(g) Private sector investment and participation will be carried out in conformance with the U.S. commitment that space activities shall be for the benefit and in the interests of all countries. Such involvement shall conform to the interest and obligation of the U.S. and our foreign policy.

2. To the extent that it is appropriate the Administration should encourage by informal means the establishment of a broad industry association, a non-profit focal point for educating and expanding the potential market, assisting that association through briefings, consultation on requirements, access to government facilities, and joint consideration of policy issues.

3. The Administration is prepared to consider flying private sector experimental and operational remote sensing sensors and payloads on government platforms.

4. The Administration should designate a lead agency to instruct the interested government agencies to define their needs and desires for services in order to provide the private sector with the best possible insight for future system design and market requirements.

5. The Administration should request the designated lead agency to work with the states and cities, and the private user community to define their needs and desires for the same purpose as above.

Whether early steps by the government would in fact elicit a positive response by the private sector cannot be assured at the time.

Conclusion

It is believed that the above approach, avoiding the early selection of a single option for a system or modality, is best suited to the present state of government and private sector readiness. This should in itself signal to the private sector the government's encouragement of *any* plausible proposals for investment in and operation of all or part of an earth resources sensing system. It should exclude no reasonable proposal and it should favor none at this time.

Further, we suggest a mechanism commensurate with the task to be performed and the public interest criteria against which proposals ought to be judged.

Earth resources satellite sensing programs are at a very difficult stage, presenting transition problems for both government and the private sector. The problems apply both to the transition from the Landsat D/D′ research and development program to an operational system, and to the potential transition from a governmental program to a private enterprise. While it is generally understood that the government wishes to encourage private sector participation, sufficient attention may not be given within government to the need to avoid putting in place new complexities which may in themselves make it more difficult for the private sector to respond to articulated government policy.